#125

Request for Tank Closure
Building 243 UST Site

ADEQ LUST File No. 4715.2988 and 4715.2989

Arizona Army National Guard
Camp Navajo
Bellemont, Arizona

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Abbreviations and Acronyms

ADEQ	Arizona Department of Environmental Quality
ADHS	Arizona Department of Health Services
ARS	Arizona Revised Statutes
AWQS	Aquifer Water Quality Standards
bgs	below ground surface
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
CFR	Code of Federal Regulations
na	not analyzed
nd	not detected
ft	feett
GWPGL	Ground Water Protection Guidance Level
HBGL	Health Based Guidance Level
in	inches
LUST	Leaking Underground Storage Tank
mg/kg	milligrams per kilogram
msl	mean sea level
ppb	parts per billion
ppm	parts per million
SSCL	Suggested Soil Cleanup Levels
TPH	Total Petroleum Hydrocarbons
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank

Section 1

INTRODUCTION

On behalf of the United States Army Corps of Engineers (USACE) Los Angeles District and Morrison Knudsen Corporation, Tetra Tech, Inc. (Tetra Tech) has prepared the following Tank Closure Request for the Building 243 underground storage tank (UST) site within the Arizona Army National Guard Camp Navajo (Camp Navajo), in Bellemont, Arizona. The scope of work has been authorized under Pre-Planned Remedial Action Contact (PRAC) No. DACW05-94-D-0017, Delivery Order No. 7 for the USACE, Los Angeles District.

1.1 Site Description and History

Camp Navajo is located in north central Arizona, in Coconino County, about 12 miles west of the city of Flagstaff (see Figure 1-1). The facility encompasses approximately 28,300 acres, divided into areas named according to the activities that were performed at these locations. Most of the existing buildings are located in the administration and warehouse areas at the northern end of the facility, which covers a small percentage of the total acreage of Camp Navajo. In the warehouse area, some buildings have been demolished and only the building pads remain. The remainder of the facility consists of open grassland and wooded hills with occasional storage buildings and munitions bunkers (Tetra Tech, 1994).

As shown in Figure 1-2, Building 243 is located in the northwest quadrant of Camp Navajo and is used as a pump house. Two 1,000 gallon steel USTs containing diesel were formerly used. One UST was located approximately 2 ft north of Building 243 (herewith designated as UST #1), and was used to provide fuel to a heater. The second UST was located approximately 4 ft east of the building (designated as UST #2) and was used to fuel a water pump. Both USTs measured approximately 12 ft in length by 4 ft in diameter. Figure 1-3 shows the former UST locations.

1.2 Subsurface Conditions

1.2.1 Regional Geology

Camp Navajo is located on the Flagstaff-Mogollon slope of the Colorado Plateau physiographic province. The facility is situated on the Plio-Pleistocene basalt field that formed from an ancient volcanic eruption over a platform of Paleozoic and Mesozoic sedimentary rocks. (Dames & Moore, 1994)

FIGURE 1-1
LOCATION OF CAMP NAVAJO

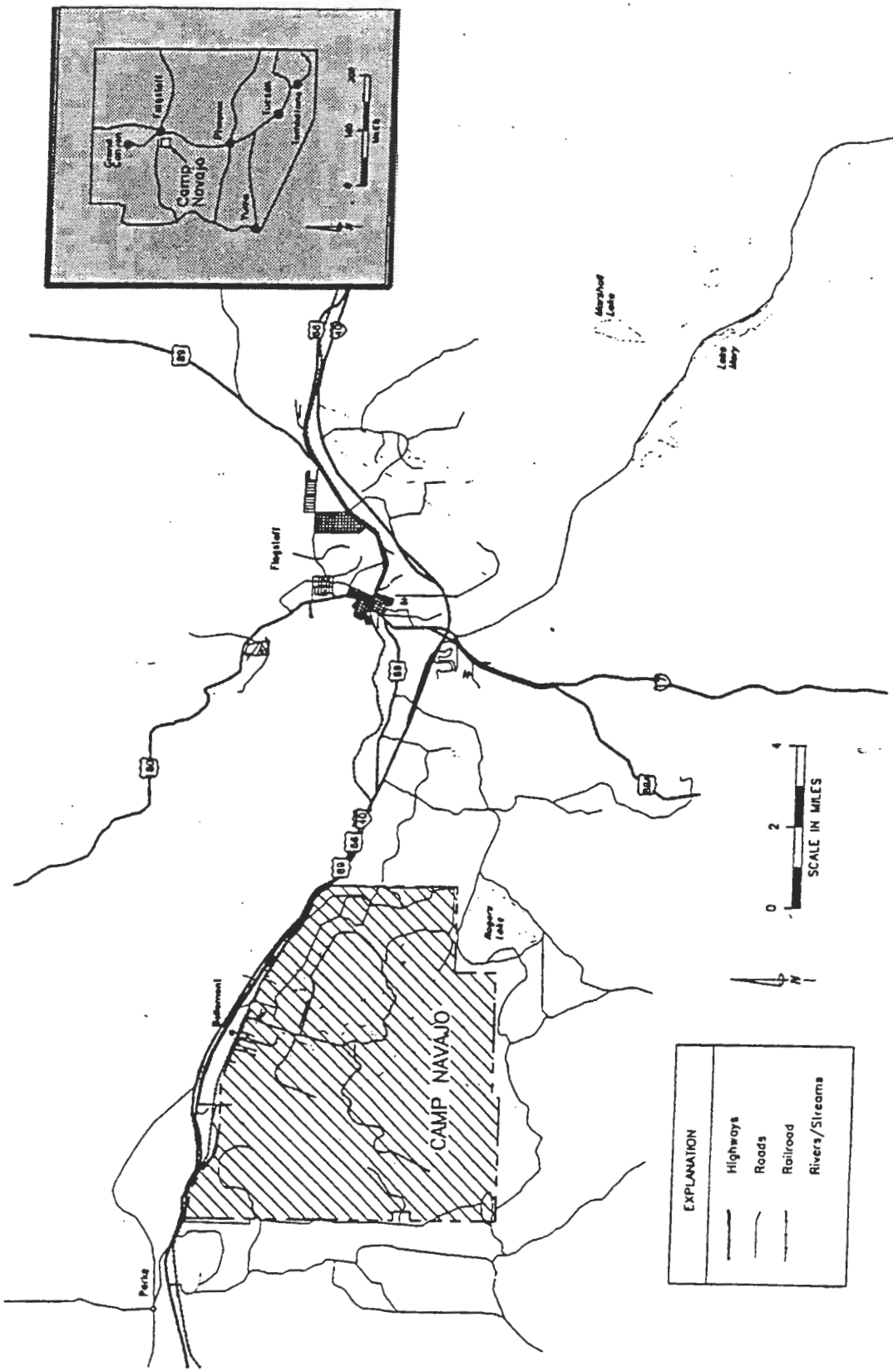


FIGURE 1-2
SITE LOCATION MAP

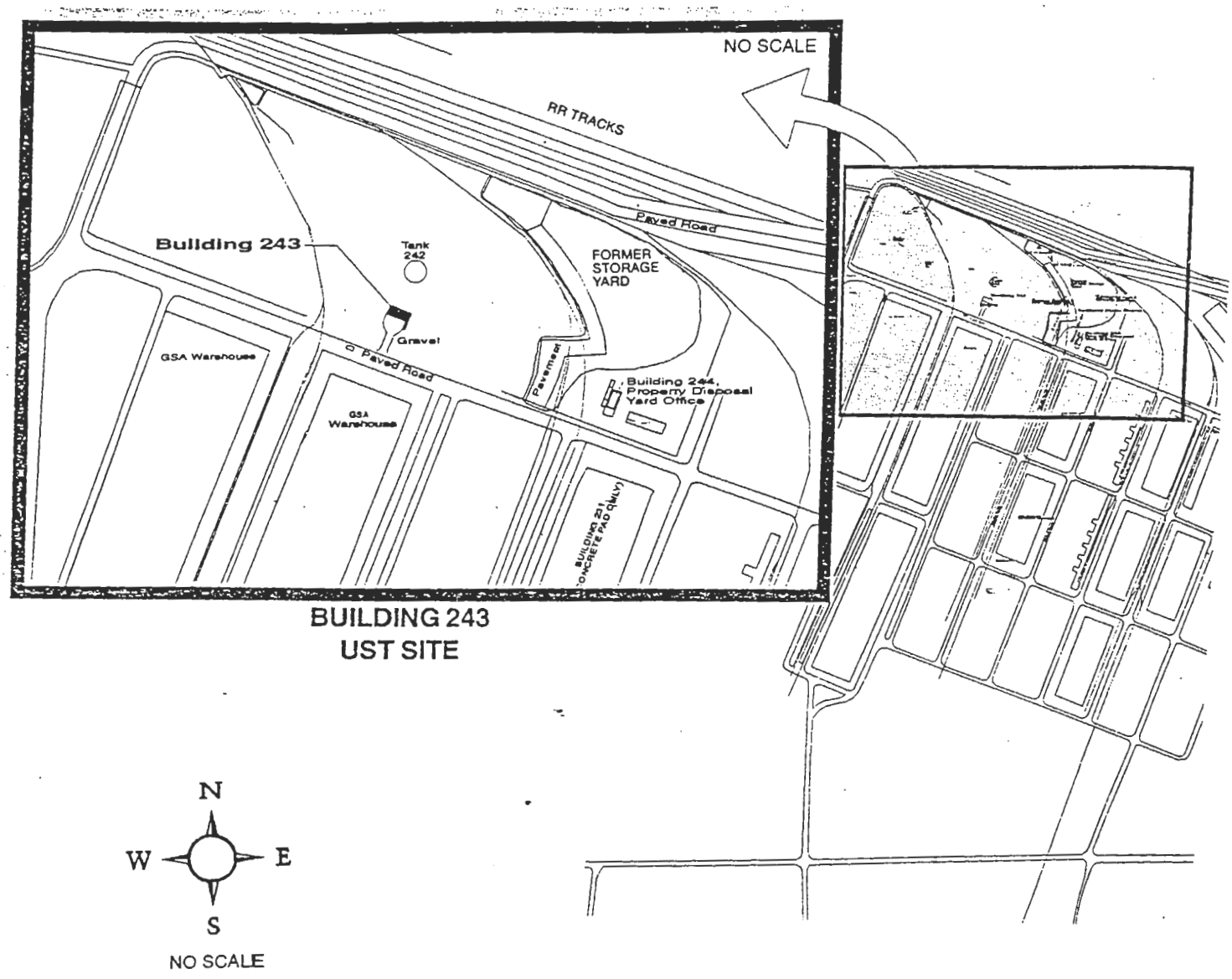
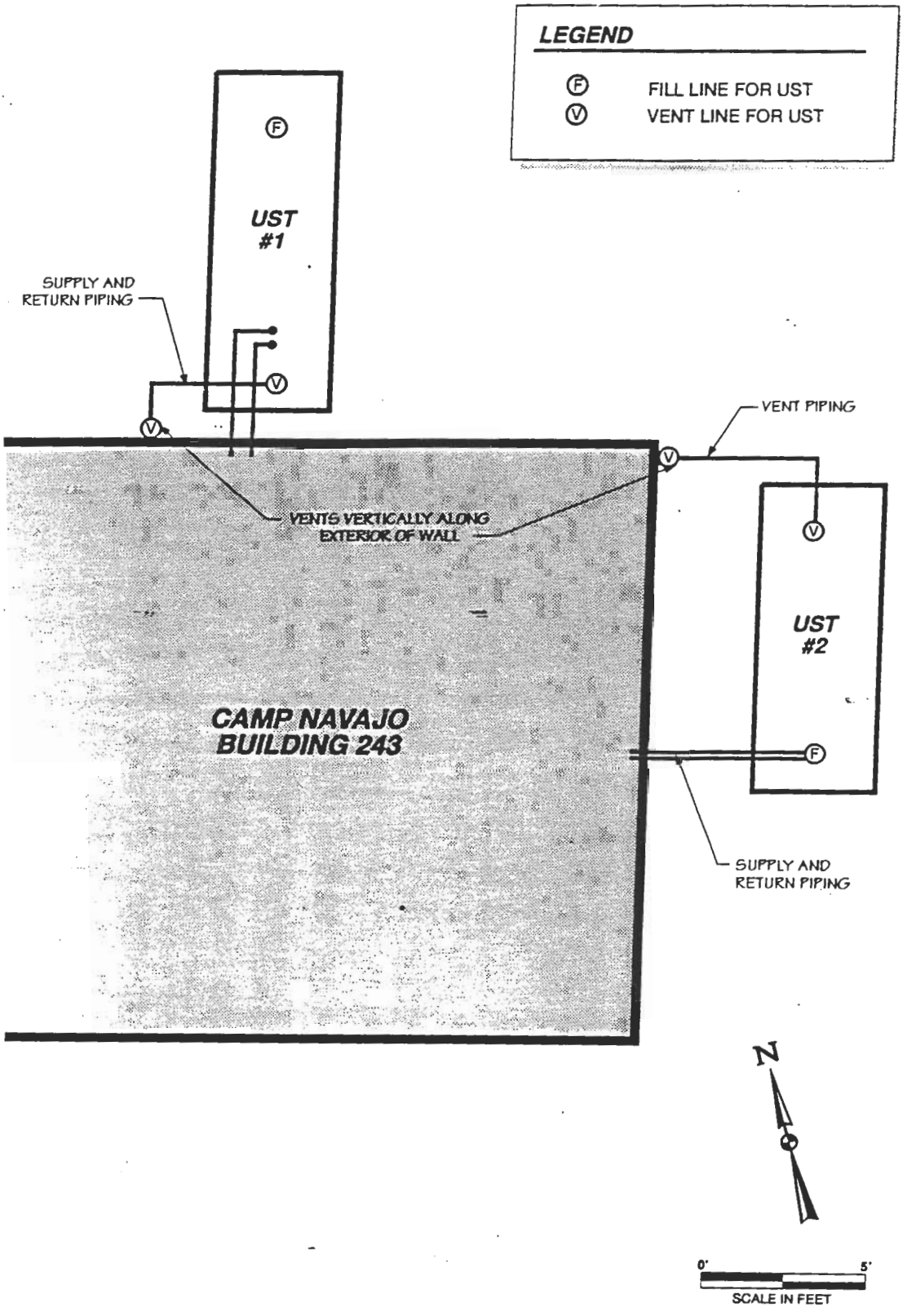


FIGURE 1-3
BUILDING 243 FORMER UST LOCATIONS



At the facility, the youngest strata are Quaternary alluvial deposits consisting of unconsolidated sand, clay and gravel derived from volcanic and sedimentary sources. These deposits are found mainly in drainage and other low areas. The next oldest geologic unit consists of Quaternary to Tertiary aged volcanic basalt flows with related scoria cones, and Miocene to late Pliocene basaltic flows and vent facies. The lavas weather to clayey gravelly soil which often contain basalt cobbles. The volcanic rocks are underlain by the Kaibab Formation, which consist of gray dolomitic limestone, sandy dolomitic mudstone, chert and sandstone. The Kaibab Formation is underlain, in descending order, by the Toroweap Formation (sandstone, shale), the Coconino Sandstone, and the Schnebly Hill Formation (sandstone, shale, dolomitic sandstone), all of which are Permo-Pennsylvanian in age.

Camp Navajo is located on an upthrown block or horst, between the Oak Creek fault to the east and the Volunteer fault along the western boundary of Camp Navajo. Relative vertical displacement on these faults is about 300 ft. A relative upward displacement of about 200 ft has also occurred along the Lockwood Fault, which forms Camp Navajo's southern boundary. Relative displacement along the Bellemont and Dunnam faults within Camp Navajo are not known.

1.2.2 Regional Hydrogeology

Ground water exists under both perched and unperched conditions in the vicinity of Camp Navajo. The primary source of the perched water is a thin gravelly soil overlying a bentonite clay unit (designated as the Navajo Army Depot unit by Wolfe, 1987). The clay is derived from Tertiary rhyolitic ash deposits. It underlies part of the ammunition workshop, warehouse, and administration areas and is preserved by overlying Quaternary basalt flows and cinders. Three springs at the top of the clay along the center of the ammunition workshop are used by Camp Navajo, to supply water.

Ground water flow in the perched aquifer is extremely complex and appears to be influenced by subsurface basalt fractures. Ground water flow generally tends to follow topography. On a local scale, the upland areas, such as the volcanic cones and ridges, are the recharge points for the shallow aquifers on site. In general, the shallow ground water in the northern Camp Navajo area flows south from recharge areas north of the depot.

The regional water table is currently encountered at a depth of about 1,345 ft below the ground surface (an elevation of about 5,695 ft above mean sea level [msl]). The regional aquifer includes the Coconino sandstone and the upper 150 ft of the Supai formation, which is a transitional zone of relatively permeable sandstone similar to the Coconino. Below this, the Supai formation becomes increasingly more shaley and less permeable. Water levels in the regional aquifer beneath the base have been steadily

declining over the years (about 80 ft since the well was installed in 1950, or more than 1.5 ft per year). The regional aquifer is tapped by a number of large production wells belonging to the city of Flagstaff. The production wells are located in the Woody Mountain Well Field, just east of Camp Navajo and east of the Oak Creek Fault. Ground water elevations in Woody Mountain wells WM-1 through WM-9 ranged between 5,870 and 6,091 ft above msl in November 1991 (Malcolm Pirnie 1989). Because the Woody Mountain Well Field is located on down-faulted blocks relative to Camp Navajo, ground water is found relatively high within the Coconino sandstone beneath the Woody Mountain Well Field.

Within the Coconino aquifer, ground water probably flows north or northeast (the pattern in the Flagstaff area) but could very well be influenced by faults in the Camp Navajo area. Based on percolation tests conducted between the perched and regional aquifers, the intervening strata do not present an effective barrier to vertical migration. The suggested mechanism for rapid vertical migration is flow along fractures associated with the Bellemont Fault zone. Rapid flow may occur through fractures in any of the consolidated or crystalline rocks, including basalt lavas, cemented sandstones, or limestone. Secondary porosity in these rocks can be far more effective at transmitting water than the primary porosity of unconsolidated formations.

1.2.3 Geology and Hydrogeology at Building 243

Building 243 is located in the northern portion of a large warehouse area. The following geologic description is compiled from surface geologic mapping and soil borings in the warehouse area.

The plateau on which the warehouse area is located is underlain by approximately 80 ft of unconsolidated sedimentary and volcanic deposits with one or more thin basalt flows. Laterally continuous, transient, perched ground water zones may occur within this depth interval. At approximately 60 ft below ground surface (bgs) is a tuffaceous clay deposit that acts as an aquitard. The principle installation water supply comes from springs that issue from the aquifer perched on this clay. The tuffaceous clay is exposed at the base of the slope along the south edge of the plateau. Three springs are located along this exposure and a small reservoir stores water to supply the water needs of the base. Beneath the clay is approximately 150 to 200 ft of interbedded alluvium and basalts that overlay the Kaibab Limestone.

The eastern edge of the warehouse area is defined by a north-south trending ridge. This ridge is the surface expression of the Bellemont Fault. The block east of the fault, which contains the administration area, has been uplifted relative to the warehouse area. The total amount of movement and the age of the last movement on the fault are unknown although the fault may be Holocene in age based on geomorphology.

1.3 Meteorology

The diurnal temperature variation in the Flagstaff area is great. The average daily maximum is 60 degrees F; the average daily minimum is 30 degrees F (EBASCO 1990). The prevailing wind direction is south by southwest, with an average speed of 7.4 mph. The months of greatest precipitation are July, August, and December. The average yearly rainfall is 20 inches, and the average annual snowfall is 82 inches. Occasional flooding of lowland areas occurs when the heavy accumulation of snow melts in the mountains. Because of the dry climate, evaporation is significant, accounting for water losses of 60 inches per year from exposed areas, such as the water storage reservoirs.

The winds in the area are from the south to southwest about 29 percent of the time, from the northeast 15 percent of the time, from the south six percent of the time, and from the west four percent of the time. Winds blow from the other directions 15 percent or less of the time. Wind speed is less than three knots 31 percent of the time, thus wind direction is unmeasurable (EBASCO 1990).

Section 2

Previous Activities

2.1 UST Removal

In 1993, Irwin-Jurkewiecz Corporation (IJC), Windham, New Hampshire, subcontracted Western Technologies to remove the USTs at Building 243. Removal activities were implemented by Western Technologies, Inc. on August 20, 1993 in accordance with the Arizona Department of Environmental Quality (ADEQ) requirements for a preliminary assessment of a UST site closure. The USTs were described as being in overall good condition, with some evidence of slight corrosion and loose fittings. Petroleum odors and/or soil discoloration were observed at the south end (fill end) of the tank excavations (Dames and Moore, 1994).

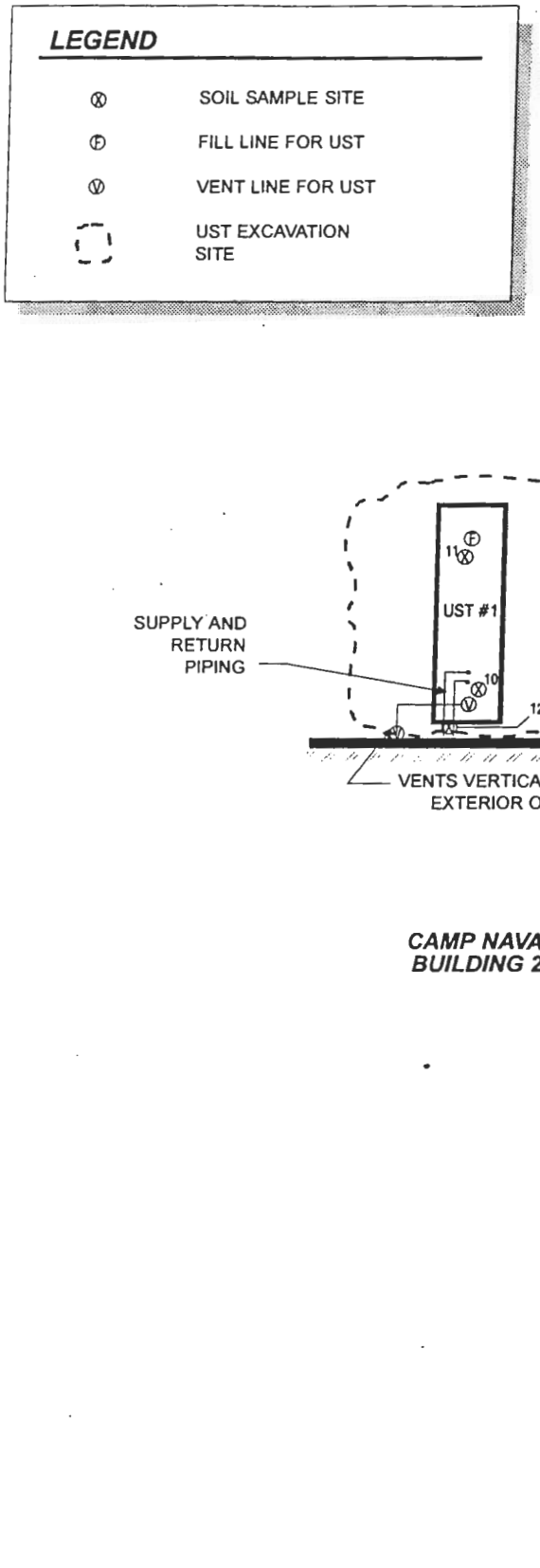
Following UST removals, soil samples were collected from the excavations to determine if the tanks had leaked. Samples were retrieved from the soil beneath each end of each tank (about 6 ft bgs) and from the excavated stockpiles; then analyzed for TPH using ADHS Method BLS-181. Detectable concentrations of a 100 mg/kg or over of TPH were found in the piping trench of UST #1 (100 mg/kg), the excavation of UST #2 (110 and 460 mg/kg) and the excavation stockpiles (130 to 2,000 mg/kg). TPH concentrations in the excavation of UST #1 were not detected. The excavated material was stored on-site for characterization and subsequently treated by thermal desorption. The UST pits were backfilled with clean fill material. Table 2-1 presents the results from the tank removals and Figure 2-1 shows sample locations.

TABLE 2-1
Soil Sample Results from August 1993 UST Removal
Building 243 UST Site

Sample ID	Collection Date	Sample Location	Sample Depth (ft)	TPH Result (mg/kg)
UST #1 (Located north of Bldg 243)				
3JE157-10	8/20/93	South end of excavation	6.5	20
3JE157-11	8/20/93	North end of excavation	6.5	nd
3JE157-12	8/20/93	Piping trench	1.0	100
UST #2 (Located east of Bldg 243)				
3JE157-8	8/20/93	South end of excavation	6.0	460
3JE157-9	8/20/93	North end of excavation	6.0	110
Soil Stockpiles from Excavation				
3JE157-13	8/20/93	UST #1 stockpile	1.0	180
3JE157-14	8/20/93	UST #1 stockpile	1.0	130
3JE157-15	8/20/93	UST #2 stockpile	1.0	2000
3JE157-16	8/20/93	UST #2 stockpile	1.0	1400

NOTES: ND - not detected above method detection limit of 10 mg/kg.

FIGURE 2-1
SOIL SAMPLE LOCATION FROM TANK REMOVAL



2.2 Site Characterization

2.2.1 Preliminary Soil Boring Program

To delineate the extent of petroleum compounds in the soil east of Building 243 (at former UST #2), a subsurface soil investigation was conducted by Dames and Moore in November 1993. Six soil borings were drilled within and around the former tank excavation to define the vertical and lateral extent of petroleum impacted soil. Because of physical constraints, no soil samples were collected beneath the adjacent building (Dames and Moore, 1994).

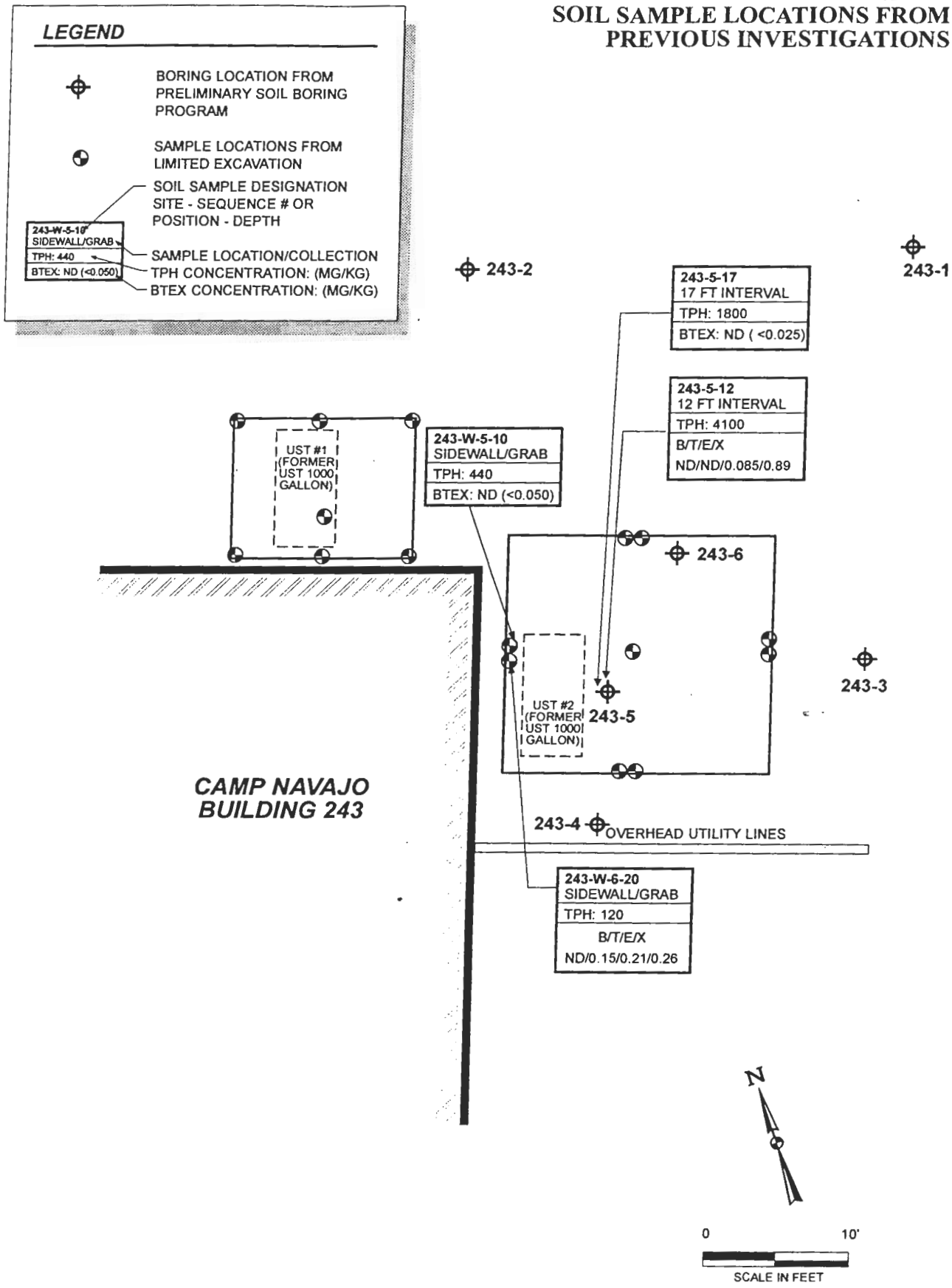
Boring depths ranged from 15 to 22 ft bgs. Deeper samples were not collected due to auger refusal on basalt bedrock. Samples were generally collected at 5-foot depth intervals for analysis of TPH compounds and Aromatic Volatile Organics (Benzene, Toluene, Ethylbenzene, and Xylenes - BTEX) by USEPA Method 8020. Of the six borings, TPH compounds were detected only in boring 243-5, located within the former tank excavation. At a depth of 12 ft bgs, TPH, ethylbenzene, and xylenes were detected at concentrations of 4,100, 0.085, and 0.89 mg/kg, respectively. Concentrations decreased at 17 ft bgs to 1,800 mg/kg and BTEX constituents were not detected. At a depth of 22 ft bgs, TPH was not detected (Dames and Moore, 1994). . Sample results and locations are presented in Table 2-2 and Figure 2-2, respectively.

TABLE 2-2
Soil Sample Results from November 1993 Investigation
Building 243 UST Site

Sample ID	Collection Date	Boring ID	Sample Depth (ft)	RESULTS				
				TPH (mg/kg)	Benzene (mg/kg)	Toluene (mg/kg)	Ethyl-benzene (mg/kg)	Xylenes (mg/kg)
243-1-5	11/8/93	1	5	nd	na	na	na	na
243-1-10	11/8/93	1	10	nd	nd	nd	nd	nd
243-2-5	11/8/93	2	5	nd	na	na	na	na
243-2-10	11/8/93	2	10	nd	nd	nd	nd	nd
243-2-17	11/8/93	2	17	nd	na	na	na	na
243-3-5	11/8/93	3	5	nd	na	na	na	na
243-3-10	11/8/93	3	10	nd	nd	nd	nd	nd
243-3-15	11/8/93	3	15	nd	na	na	na	na
243-3-20	11/8/93	3	20	nd	nd	nd	nd	nd
243-4-5	11/9/93	4	5	nd	na	na	na	na
243-4-10	11/9/93	4	10	nd	nd	nd	nd	nd
243-4-15	11/9/93	4	15	nd	na	na	na	na
243-4-20	11/9/93	4	20	nd	nd	nd	nd	nd
243-5-9	11/9/93	5	9	nd	nd	nd	nd	nd
243-5-10	11/9/93	5	10	27	nd	nd	nd	nd
243-5-12	11/9/93	5	12	4100	nd	nd	0.085	0.89
243-5-17	11/9/93	5	17	1800	nd	nd	nd	nd
243-5-22	11/9/93	5	22	nd	nd	nd	nd	nd
254-6-12	11/9/93	6	12	nd	nd	nd	nd	nd

NOTES:
ND - not detected above the method detection limit of 20 mg/kg for TPH and 0.025 mg/kg for BTEX.
NA - not analyzed.

FIGURE 2-2
SOIL SAMPLE LOCATIONS FROM PREVIOUS INVESTIGATIONS



2.2.2 Limited Soil Excavation Program

To further delineate and remove contaminated soil around UST #2 and the piping trench of UST #1, an overexcavation was conducted on October 3, 4, and 10, 1994. As shown in Table 2-3, detectable TPH concentrations were reported only in the sidewall clearance samples collected from the west end of the UST #2 excavation, approximately 2 ft from Building 243. Samples reported a maximum of 440 mg/kg TPH at 10 ft bgs in the soil adjacent to the building. The excavation extended to approximately 6 to 8 inches from the building footing. Clearance samples were collected from the excavation floor and sidewalls to document the extent of soil contamination (Dames and Moore, 1995). Since no further excavation could be conducted toward the building, the pit was backfilled to grade with pea gravel (Dames and Moore, 1995). A summary of the results of the final clearance samples is presented in Table 2-3. Sample locations are depicted in Figure 2-2.

TABLE 2-3
Soil Sample Results From October 1994 Limited Excavation
Building 243 UST Site

Sample ID	Sample Location	Sample Depth (ft)	RESULTS				
			TPH (mg/kg)	Benzene (mg/kg)	Toluene (mg/kg)	Ethyl-benzene (mg/kg)	Xylenes (mg/kg)
UST #1 (Located north of Bldg 243)							
243-1-4	Sidewall grab north center	4	nd	na	na	na	na
243-2-4	Sidewall grab northeast corner	4	nd	na	na	na	na
243-3-4	Sidewall grab southeast corner	4	nd	na	na	na	na
243-4-4	Sidewall grab south center	4	nd	na	na	na	na
243-5-4	Sidewall grab southwest corner	4	nd	na	na	na	na
243-6-4	Sidewall grab northwest corner	4	nd	na	na	na	na
243-7-8	Bottom grab	8	nd	na	na	na	na
UST #2 (Located east of Bldg 243)							
243-E-1-10	Sidewall grab	10	nd	na	na	na	na
243-E-2-20	Sidewall grab	20	nd	na	na	na	na
243-N-3-10	Sidewall grab	10	nd	na	na	na	na
243-N-4-20	Sidewall grab	20	nd	na	na	na	na
243-W-5-10	Sidewall grab	10	440	nd	nd	nd	nd
243-W-6-20	Sidewall grab	20	120	nd	0.15	0.21	0.26
243-S-7-10	Sidewall grab	10	nd	na	na	na	na
243-S-8-20	Sidewall grab	20	nd	na	na	na	na
243-B-9-20	Bottom Grab	20	nd	na	na	na	na

NOTES: Samples were collected on October 3, 4, and 10, 1994.
ND - not detected above the method detection limit of 40 mg/kg for TPH and 0.050 mg/kg for BTEX.
NA - not analyzed.

Section 3

Applicable Regulations and Requirements

The Arizona Department of Environmental Quality (ADEQ) currently serves as the lead agency for leaking underground storage tank (LUST) oversight programs. The ADEQ task force has recently revised guidance on remediation levels. The Soil Remediation Rules (R18-7-201) were promulgated in March 1996 and supersedes the LUST Interim Soil Remediation policy. The suggested soil cleanup levels (SSCL) are no longer appropriate for use as default. As of August 1996, the ADEQ cleanup standards are dependent upon health based guidance levels (HBGLs) or ground water protection guidance levels (GWPGLs) depending on ground water depth. The HBGLs may be used only if ADEQ criteria for ground water protection, ecologic risk, and public nuisance are satisfied (ADEQ, 1996). Table 3-1 lists the appropriate HBGLs and GWPGLs.

TABLE 3-1
CURRENT ADEQ SOIL CLEANUP LEVELS
PETROLEUM IMPACTED SITES

Cleanup Criteria	TPH (mg/kg)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (mg/kg)
Category 1(a) HBGL (residential)	7,000	47	23,000	12,000	230,000
Category 1(b) HBGL (non-residential)	24,500	197	80,500	42,000	805,000
Category 2(a) or 2(b) HBGL (residential or non-residential)	CLEANUP LEVELS ESTABLISHED BY SITE SPECIFIC RISK ASSESSMENT				
GWPGL	--	0.71	400	120	2,100

Reference: Arizona Department of Environmental Quality, August 1996.

Notes:

1) Cleanup levels based on HBGLs at or below these levels must protect against:
   a) ground water contamination in excess of the aquifer water quality standards (AWQS) or the drinking water HBGLs if no AWQS exists;
   b) adverse impact on sensitive environments;
   c) a public or environmental nuisance or hazard.
2) GWPGLs are required if contamination is within 10 meters (33 ft) of the water table or less.

Section 4

Recommendation / Site Closure

The two 1,000 gallon USTs have been removed and characterized in accordance with applicable ADEQ tank closure requirements (ADEQ, 1994), Arizona Revised Statutes (ARS) Title 49, Chapter 6, section 49-1008, and Title 40 of the Code of Federal Regulations (CFR) Part 280, Subpart G. All soil excavated from removal activities of the two USTs were treated by thermal desorption.

Samples collected from under the former UST #1 after a limited excavation were analyzed for TPH and found to be not detected. Based on these results, no further investigation was conducted. Subsurface investigations conducted after removal activities of UST #2, have served to further delineate the extent of impacted soil. A limited excavation of soils was conducted with remaining detectable concentrations of TPH at 440 mg/kg (10 ft bgs) and 120 mg/kg (20 ft bgs) found on the west wall of the excavation. Toluene, ethylbenzene, and xylenes were detected at 0.15, 0.21, and 0.26 mg/kg, respectively (20 ft bgs). These results are below the current ADEQ HBGL soil cleanup standards (as shown in Table 3-1).

The maximum depth of remaining soil contamination was found at 20 ft bgs. The depth to ground water from this point may be less than 10 meters, therefore the GWPGLs should be considered. The detected results for TPH (440 mg/kg at 10 ft bgs and 120 mg/kg at 20 ft bgs), toluene (0.15 mg/kg), ethylbenzene (0.21 mg/kg) and xylenes (0.26 mg/kg) are well below the minimum GWPGLs for soils.

The remaining impacted soil is locally confined beneath Building 243. It is isolated from any precipitation drive force, does not have foreseeable adverse impacts to the surrounding environment, and does not pose a public nuisance or hazard.

Based on the removal of the contamination source, the analytical results from additional investigations, the location of remaining impacted soils, and current HBGLs and GWPGLs, no further action is warranted for the site. Tank closure is requested from ADEQ for Building 243 UST #1 and #2 (ADEQ LUST File No. 4715.2989 and 4715.2988, respectively).

Section 5

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